HIGH-ORDER BICOMPACT SCHEMES FOR SOLVING CONTINUUM MECHANICS PROBLEMS

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Bicompact schemes are finite-difference schemes on a template occupying one grid cell in space. A high order of approximation in them is achieved by introducing additional dependent variables that are assigned to integer nodes at the vertices of cells [1] or to fractional nodes on edges, faces, and inside cells [2]. These unknowns are determined from relationships that can be viewed as discrete analogues of derivatives of the equations being solved.

Bicompact schemes have several advantages. The amplitude and phase errors of these schemes are significantly smaller compared to standard and compact finite-difference schemes of equal order of approximation [3]. Difference boundary conditions for bicompact schemes are set naturally, by projecting the boundary data of the differential problem onto the grid. Bicompact schemes have high stability due to implicit and implicit-explicit integration in time, but are implemented efficiently by the two-point sweep method.

The talk is devoted to the theory and applications of bicompact schemes. The methods for constructing schemes of this type for hyperbolic [4] and parabolic [5] equations are described. The results of stability analysis and, when solving hyperbolic equations, monotonicity and dissipative, dispersion properties are presented. Methods for efficient implementation in the multidimensional case are discussed. The numerical results of non-stationary problems for the Euler and Navier-Stokes equations are presented. The emphasis is on flows that simultaneously include strong discontinuities and smooth waves or vortices. A comparison with other high-order schemes is made. A significant advantage of bicompact schemes in accuracy and/or computational speed is demonstrated.

References

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